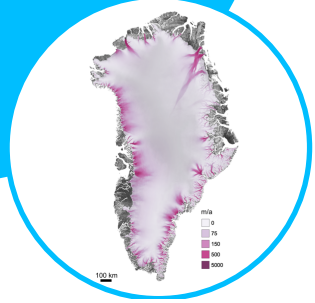
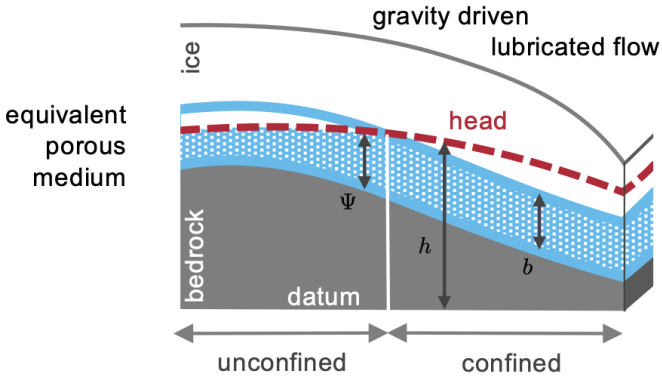
M.Sc. Thesis
Research Project
SimTech /
Computer Science / ...

SimTech

Coupled Ice Sheet – Subglacial Hydrology Simulations Cooperation with AWI



The dynamics of the Greenland Ice Sheet is driven by the interaction between glaciers and the underlying subglacial hydrological system. Melt water at the ice sheet base, as well as seasonal input from surface melt water is forming a subglacial hydrological environment, that is simulated using an equivalent porous medium approach. The dynamics of the ice sheet is modeled as a thermo-mechanical fluid with a non-Newtonian rheology. For both compartments, performant parallel C++ codes exist, which are coupled using the coupling library preCICE [a]. The ice sheet code is a finite element 3D code, ISSM [b], while the subglacial hydrology code is a finite difference 2D code, CUAS-MPI [c]. The time scale of both systems is normally different, with hourly time steps in the hydrological system and monthly time steps in the ice sheet. To goal of this student project is to better understand the effect of different coupling algorithms (explicit vs. implicit, serial vs. parallel) on the evolution of both systems. To this end, a benchmark scenario based on an artificial geometry (Thule domain) should be used (CalvingMIP [d]).



[a] https://precice.org/
[b] issm.jpl.nasa.gov
[c] https://github.com/tudasc/CUAS-MPI
[d] https://github.com/JRowanJordan/CalvingMIP/wiki/Thule-domain

Work packages

- Setup the Thule domain for both models, ISSM and CUAS-MPI
- Conduct spin-up simulations individually for both ice sheet and subglacial hydrology
- Realize and investigate the effect of different coupling schemes
- Provide coupled case as preCICE tutorial

Technical requirements

- Working knowledge in C++
- Basic know-how of numerical simulation
- Interest in learning more about ice sheet modeling and beyond

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